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D1F 52

(72) Inventors DEREK PEAT and TREVOR ALFRED FARRAR

(54) TENSIONING AND/OR SLACK TAKE-UP DEVICE FOR FLEXIBLE MATERIAL IN SHEET OR THREAD FORM

(71) We, NATIONAL RESEARCH DEVELOPMENT CORPORATION, a British Corporation established by Statute, of Kingsgate House, 66—74 Victoria Street, London SW1E 6SL, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

In situations where a flexible material in continuous thread or sheet form is drawn to a station at which the material is wound, woven, knitted, or otherwise processed, it is commonly necessary to tension the material and to arrange for any slack which may occur in the material to be taken up. This invention relates to a device with which the desired tensioning and/or slack take-up can be achieved by frictional drag imposed by a fluid stream through which the material is drawn.

According to the invention a device for tensioning and/or taking up slack in a flexible material of continuous thread or sheet form comprises a tube having an opening at each end and arranged so that the material can be drawn unobstructed through the tube, the tube comprising a section of expanded internal cross-section along part of its length (hereinafter referred to as the expanded section), an unexpanded section of uniform cross-section between the expanded section and one end of the tube, and a flared section at each end of the unexpanded section, one flared section leading from the unexpanded section to the expanded section, and the other flared section leading from the unexpanded section to the opening at the said one end of the tube, the axial length of the unexpanded section being greater than the sum of the axial lengths of the flared sections at its opposite ends, and a branch passage which opens laterally into the expanded section and which has an internal cross-sectional area greater than that of the unexpanded section, the branch passage being arranged for connection to means for continuously creating a pressure in the branch passage and in the expanded section different from the ambient pressure beyond the ends of the tube so that, in use, a pressure differential causes fluid to flow along the tube and exert a drag on material drawn through it. Usually, the fluid which is caused to flow along the tube will be air, although the device can be operated with an alternative fluid if desired and the situation is suitable.

In situations where the material which is drawn through the device is required to be tensioned, preferably the expanded section of the tube is located near one end of the tube, and the opening at this end of the tube is arranged with a cross-sectional area which is significantly less than that of the unexpanded section of the tube and of the opening at the other end of the tube so that, in use, a substantial majority of the fluid which flows along the tube passes through the larger opening remote from the expanded section of the tube. In this case the fluid flow along the tube is substantially unidirectional, and when the material is drawn through the tube in the opposite direction, the frictional drag applied to the material by the fluid flow tensions the material.

By arranging that the material is drawn linearly and obstructed through the tube the only frictional drag on the material is applied by the fluid flow, and consequently a relatively steady tension can be maintained continuously in the material. The applied

tension can be adjusted as desired simply by adjusting the rate of fluid flow through the tube. Contact of the material with the internal walls of the tube is to be avoided since this will exert an additional and variable frictional drag on the material which would upset the applied tension. The provision of the expanded section of the tube and the branch passage having a greater cross-sectional area than the unexpanded section of the tube serves to avoid unwanted frictional contact of the material with the tube, particularly at the junction of the branch passage and the tube where there is some tendency for deflection of the material to occur due to the change in direction which the fluid flow through the device must undergo at this point.

Furthermore, this arrangement serves to keep as little as possible the loss in fluid energy which occurs due to the fluid flow having to change direction at the junction between the branch passage and the tube. Because the unexpanded section of the tube has a smaller cross-sectional area than the branch passage the fluid flow through the tube is at relatively high velocity, which is suited to tensioning the material, and the fluid flow through the branch passage is at a relatively low velocity. The fluid flow therefore changes direction at the junction at the lower velocity and the energy expended in doing this is much less than would be required at the higher velocity. Preferably the internal cross-secional area of the branch passage is at leaast twice as great as that of the unexpanded section of the tube.

The device may be arranged to operate either with a positive pressure differential or with a negative pressure differential between the expanded section of the tube and the surroundings at the ends of the tube. In the former case, means for supplying the fluid under pressure is, in operation, connected to the branch passage so that the fluid is forced along the tube and out of the opening at the end remote from the expanded section. In the latter case, a suction is applied to the branch passage and fluid is drawn into and along the tube from its ends remote from the expanded section. The means for creating the pressure differential may be a pump, the branch passage being connected to the pump inlet for creating a negative pressure differential and to the pump outlet for creating a positive pressure differential. The pump may, if desired, form part of the device, being permanently connected to the branch passage.

When the device is being used to tension the material which is drawn through it, any slack which occurs in the material downstream from the device, is automatically taken up by the action of the fluid flow in the device, and the tension in the material downstream from the device is thereby maintained. When the device is operated with a positive pressure differential the slack is taken up in a loop of the material which is formed beyond the end of the device through which the fluid exhausts. When the device is operated with a negative pressure differential however, the slack is taken up in the form of a loop which is drawn into the branch passage, the construction of the device in accordance with the invention enabling this to occur without difficulty. When the material is again drawn and the taken up slack is removed, there is virtually no snatching of the material since only the inertia of the material itself needs to be overcome. This is in contrast with mechanical slack take-up devices such as a sprung arm which acts constantly on the material and possesses considerable inertia as well as applying a variable frictional drag to the material.

Since the device will be in operation continuously for as long as the material is drawn through it, for economic reasons it will be desirable to keep the fluid energy expended by the device as low as possible. Therefore, the cross-sectional area of the unexpanded section of the tube is preferably made as small as possible consistent with maintaining the substantially unidirectional flow of fluid through the tube and achieving the desired frictional drag on the material. Additionally, as a result of the flared sections at the opposite ends of the unexpanded section of the tube, when the device is used with a positive pressure differential the fluid flowing through the tube will slow down in the flared section at the end of the tube and reduce the back pressure, which will limit the energy flow through the tube and thereby require less fluid energy to be supplied in order to achieve the required tension. A similar effect will be achieved in devices which are used with a negative pressure differential, the fluid flow slowing down in the flared section between the unexpanded section and the expanded section of the tube.

The size of the smaller opening at the end of the tube nearer the expanded section of the tube should preferably be no more than is sufficient to allow unobstructed passage of the material which is drawn through the tube, that is without any substantial likelihood of the material catching in the opening because of kinks, knots, or other irregularities which may reasonably occur in the material. Consequently the size of the unexpanded section of the tube will usually be a compromise between making it as large as possible to ensure a substantially unidirectional flow of fluid through the tube while making it is small as possible

in order to minimise the fluid energy used in obtaining the desired tension in the material.

When the device is to be used with a positive pressure differential, achieving the necessary unidirectional fluid flow may be facilitated by arranging that the smaller opening at the end of the tube nearer the expanded section of the tube is provided by a tubular guide which projects coaxially into the expanded section, preferably beyond the point at which the axis of the branch passage intersects the tube axis. Furthermore, the inside of the tubular guide may be formed with a series of axially spaced chambers which act as buffers to the escape through the tubular guide of fluid from within the expanded section, provided of course the guide still allows free and unobstructed passage through it of the material. One way of achieving the desired buffer chambers within the tubular guide is to arrange that the inner wall of the guide appears castellated when an axial section through it is viewed.

A device in accordance with the invention may also be used in situations where any slack which occurs in the the material which is drawn through the device should be taken up as rapidly as possible, and there is no desire or necessity to add tension to the material. In this case the device is preferably arranged with the tube having two unexpanded sections arranged one between the expanded section and each end of the tube, and the tube being symmetrical about the expanded section. The device is operated with a negative pressure differential by applying suction to the branch passage, equal amounts of fliud being sucked in opposite directions through the two ends of the tube so that the tensions imparted to the material as a result of the fluid flows are equal and opposite and the net tension applied to the material by the device is zero. However, any slack which occurs in the material, either upstream or downstream from the device will immediately be taken up by the device in the form of a loop of material which is drawn into the branch passage.

When a device in accordance with the present invention is in operation, the pressure in the expanded section of the tube should remain fairly constant irrespective of whether the pressure differential is positive or negative. If for some reason the presence of material in the tube ceases, for example because of breakage in the material, the fluid flow through the unexpanded section or sections of the tube will increase and the pressure in the expanded section will change accordingly. By providing the expanded section of the tube with a pressure sensitive device which is adapted to provide a signal when the pressure reaches a predetermined value, the device in accordance with the invention will also operate to indicate any break in the material which is drawn through it. This arrangement can be made particularly sensitive in the pure slack take-up device described earlier since no net tension is required to be applied to the material and the size of the unexpanded sections of the tube can be reduced so that the rate of flow of fluid through the tube when the material is present is appreciably different from the rate when the material is not present.

The cross-sectional shape of the tube will usually depend on the material with which the device is to be used. For example, if the material is in the form of a continuous web or sheet, the cross-sectional shape of the tube will be oval or rectangular, having dimensions determined by the width and thickness of the material. An example of the use of a device in accordance with the invention for tensioning a continuous web may be in the winding from one roll to another of thin sheet material having a relatively low tensile strength, such as reconstituted tobacco in sheet form. By arranging that the sheet is drawn through the device, which is located between the wind-off and wind-on rollers, a tension can be applied to the sheet which is very near the breaking strain of the sheet. This is not possible using conventional mechanical tensioners because snatching, which is inherent with mechanical tensioners, will break the sheet.

Usually however, the device in accordance with the invention will be designed to tension and/or take up slack in continuous thread like materials, and accordingly the cross-sectional shape of the tube will usually be circular. Such a device is particularly suitable for use in textile machines, especially weft knitting machines, having a system for guiding yarn from a yarn package to a feeder, and in which tensioning and/or take-up of slack in the yarn at the feeder is required. The device is arranged in the yarn guiding system so that yarn drawn to the feeder passes straight through the tube, and means, usually a pump, are connected to the branch passage for creating the pressure differential in the expanded section of the tube which causes fluid, which will usually be air, to flow along the tube.

Some other examples of textile machines in which the device may be used are weft insertion looms, in which the weft yarn is tensioned as it is fed to a feeder from which a length is inserted across the warp shed on a stream of air or water in each loom cycle and is then cut prior to the next cycle, and warp knitting machines in which a number of additional warp yarns are knitted with the basic warp yarns in order to work a pattern into the fabric. The number of these additional patterning yarns may vary, but is

usually very small compared with the number of basic yarns so that it is impractical to tension these with a common tensioner bar as with the basic yarns. In this case each additional yarn may be tensioned by a device in accordance with the present invention.

Three examples of a device in accordance with the present invention and one example of the device in use will now be described with reference to the accompanying drawings, in which:—

Figure 1 is a diagrammatic axial section through one example of the device;

Figure 2 is a diagrammatic axial section through a second example of the device;

Figure 3 is a diagrammatic axial section through a third example of the device; and

Figure 4 illustrates diagrammatically the yarn feed system of a feeder in a weft knitting machine of the flat bed type, the system including a device similar to that shown in Figure 1.

The device shown in Figure 1 comprises a tube 1 having a cylindrical bore 2 which widens sharply towards one end into an expanded section 3 which has a cross-sectional area which is slightly greater than twice that of the uniform unexpanded section of the bore 2. A cylindrical branch passage 4 opens laterally into the expanded section 3. The axis of the branch passage 4 is perpendicular to that of the tube 1 and its internal cross-sectional area is substantially equal to that of the expanded section 3. At the end 5 of the tube 1 adjacent its expanded section 3 the tube 1 is closed apart from a relatively small diameter guide tube 6 which extends coaxially into the expanded section 3 as shown. At the opposite end of the tube 1 the bore 2 flares gradually, as shown at 7 to form an open mouth 8 at the end of the tube 1.

The device is designed for tensioning and taking up slack in a yarn which is drawn through the device as indicated by the arrowed dotted line 9. The outlet from an air pump, or a source of air under pressure, is connected to the free end of the branch passage 4 (not shown) so that a positive pressure differential is created in the expanded section 3 with respect to the ambient pressure beyond the open mouth 8 of the tube 1, and a stream of air is thereby caused to flow uniformly along the bore 2 from the expanded section 3 towards and out of the open mouth 8. This airstream flows in the opposite direction to the yarn 9 which is drawn through the device and imparts a tension to the yarn. If slack occurs in the yarn at the points to which it is drawn, the tension imparted by the device immediately takes up this slack as a loop which is formed beyond the open mouth 8, and the tension in the yarn through the device is maintained.

The device shown in Figur 2 comprises a tube 11 having a cylindrical bore 12 which flares gradually, as shown at 13, into an expanded section 14 at one end of the tube 11. A cylindrical branch passage 15 opens laterally into the expanded section 14, the axes of the tube 11 and the branch passage 15 being perpendicular to each other and the internal cross-sectional area of the branch passage being greater than that of the bore 12. The end 16 of the tube 11 adjacent the expanded section 14 is closed apart from a relatively small diameter central opening 17. At the other end 18 of the tube 11 the bore 12 is wide open, having a diameter much greater than that of the opening 17.

The device is designed for tensioning and taking up slack in a yarn which is drawn through the device as shown by the arrowed line 19. The free end of the branch passage 15 (not shown) is connected to the inlet of an air pump so that suction is applied to the branch passage and a negative pressure differential with respect to the ambient pressure beyond the end 18 of the tube 11 is created in the expanded section 14. Consequently an airstream is sucked along the bore 12 in the opposite direction to the yarn 19 which is drawn through the device and thereby imposes a frictional drag on the yarn which tensions the yarn. Because of the relative sizes of the openings 17 and 18 at opposite ends of the tube 11 very little air is sucked through the opening 17. If slack should occur in the yarn at the point to which the yarn is drawn, this is immediately taken up by the tension which is applied to the yarn, and a slack loop, indicated by the dotted line 19^1, is drawn into the branch passage 15.

The device shown in Figure 3 comprises a tube 21 having a bore 22 which comprises equal sections at opposite ends separated by a central expanded section 23. Each bore section 22 flares gradually into the expanded section 23 as shown at 24. A cylindrical branch passage 25 opens laterally into the expanded section 23, the axes of the branch passage 25 and the tube 21 being perpendicular to each other. The internal cross-sectional areas of the branch passage 25 and the expanded section 23 are more than twice that of the bore 22. The bore 22 is open at both ends 26 and 27, and apart from the branch passage 25 the tube 21 is symmetrical about its mid point.

The device is designed purely for taking up slack in a yarn which is drawn through the device as indicated by the line 28. An air pump is connected to the free end of the branch passage 25 (not shown) so that suction is applied to the passage 25 and a negative pressure differential with respect to the ambient pressure beyond the ends 26

and 27 of the tube is created in the expanded section 23. This causes air to flow into the expanded section 23 through the bore 22 from the opposite ends 26 and 27 of the tube 21. Because of the symmetry of the tube 21 the tensions imparted to the yarn 28 by the air flows are equal and opposite, and the net tension applied by the device is therefore zero. If any slack occurs in the yarn 28 beyond either end of the device the slack is immediately taken up in the form of a loop drawn into the branch passage 25 as shown by the dotted line 29.

Figure 4 illustrates the device shown in Figure 1 installed in the yarn feed system of one of the feeders of a weft knitting machine of the flat bed type (sometimes known as a power flat or v-bed machine). In the yarn feed system shown, yarn 31 is drawn from a yarn package 32 and passes via a series of pot eye guides 33 to a conventional cymbal tensioner 34. From this the yarn 31 passes around an overdriven cylinder 35 which is arranged to be driven so that its peripheral speed is a number of times greater than the yarn feed speed. The yarn 31 leaves the overdriven cylinder 35 and passes in a substantially straight line, when under tension, through a pot eye guide 36 into the open end 8 of the tensioning and slack take-up device in accordance with the invention and out of the guide tube 6 to the yarn feeder 37 which is mounted on a support bar (not shown) above the needle beds 38 of the machine.

The branch passage 4 of the tensioning and slack take-up device is connected to the outlet of an air pump 39, the inlet 40 of which draws air from the atmosphere as shown by the arrow 41. Air is therefore pumped into the expanded section 3 of the tube 1, and as explained earlier, the airstream which escapes along the bore 2 in the opposite direction to the passage of the yarn 31 applies a tension to the yarn. Adjacent the open end 8 of the tube 1 is a cylinder 42 which is arranged so that the airstream from the tube 1 passes tangentially over its upper surface, which acts as an aerofoil and deflects the airstream downwards away from the overdriven cylinder 35. Any slack in the yarn which may occur at the feeder 37 is immediately taken up by the airstream which is blown along the bore 2 and forms a loop (shown by the dotted line 43) between the pot eye guide 36 and the aerofoil cylinder 42 as a result of the airstream being deflected by the aerofoil cylinder.

In weft knitting machines of the flat bed type, each feeder which is used in the knitting of any course is moved along its support bar above the needle beds 38 by means of a cam carriage (not shown). The carriage generally moves the whole length of the needle beds during each course irrespective of whether or not fabric is being knitted on all of the needles. When the knitting is confined to the needles in only a part of the needle beds, as indicated for example between the arrows 44 and 45, the machine is arranged so that each feeder 37 is disengaged by the cam carriage shortly after passing the knitting section of the needles, and is picked up again as the carriage returns during the next course. The two rest positions of the feeder 37 in the system shown in Figure 4 are indicated by the arrows 46 and 47. When the feeder 37 is picked up by the cam carriage it is moved through the distance between the rest position 46 or 47 of the feeder 37 and the adjacent end or selvedge 44 or 45 respectively of the knitting section of the needle beds and then a little further before knitting actually commences and starts to draw the yarn 31. When knitting commences it is essential that the yarn 31 at the feeder 37 is in tension, otherwise there is a tendency to miss loops and to produce poor selvedges. During this initial movement of a feeder 37 prior to commencement of knitting, there is no consumption of the yarn and hence any reduction in the path length of the yarn from that in the rest position of the feeder to that at the position of the feeder at commencement of knitting will cause slack and loss of tension in the yarn. In order to take up any slack which is produced in the yarn so that the yarn is in tension as knitting commences after take-up of the feeder from a rest position, it is necessary to provide the system guiding the yarn to the yarn to the feeder with means for taking up the slack.

Conventionally, tension is produced in the yarn by means of a cymbal tensioner, and any tendency for the yarn to slacken is counteracted by means of a sprung arm which acts to urge the yarn between a pair of pot eyes to move laterally of the straight line position between the two pot eyes. This arrangement has a number of disadvantages, the main one being that the sprung arm has an inertia which must be overcome when knitting commences after the yarn has been operative to take up slack in the yarn. This causes snatching of the yarn and a variation in tension while the sprung arm is drawn back to its normal operative position between the pot eyes compared with the tension which is applied when the yarn is again drawn through the cymbal tensioner.

However, with a tensioning and slack take-up device in accordance with the invention in the yarn feed system as shown in Figure 4, any slack which would occur in the yarn at the feeder 37 is automatically

taken up in forming the loop 43; and consequently a relatively steady tension is maintained continuously in the yarn 31 at the feeder 37. When the knitting commences there is virtually no snatch on the yarn since there is only yarn inertia to overcome as the yarn is drawn back from the slack loop 43, and therefore this arrangement is generally much better than the conventional sprung arm slack take-up arrangement.

It is desirable from the point of view of quality of fabric produced that the tension in the yarn at the feeder while knitting occurs should remain as constant as possible, but as yarn is drawn off a yarn package there is inevitably fluctuation in the yarn tension; the magnitude of the fluctuations being dependent on the way in which the package is wound, the type of yarn, and whether the yarn was dyed on the package or was rewound after drying. These fluctuations can be ignored if they are relatively small compared with the basic tension applied to the yarn, but when the fluctuations are relatively large they must be reduced in some way.

In the yarn feed system shown in Figure 4 a basic tension is applied to the yarn by the cymbal tensioner 34, and relatively large fluctuations occur in this tension, particularly when dyed on the package yarns are used. The value of the basic tension and the fluctuations are substantially reduced by the over driven cylinder 35 which, as is known, reduces the yarn tension depending on the degree of wrap around of the yarn and the difference in the peripheral speed of the cylinder 35 and the speed at which the yarn is drawn by the feeder. The tensioning device in accordance with the invention then adds to the reduced tension a substantially constant tension which brings the total tension in the yarn 31 to the desired value. Compared with this total applied tension, the fluctuations which have been reduced effectively by the overdriven cylinder 35 are relatively small and can be tolerated. As an alternative to the overdriven cylinder 35, the yarn feed system may use an IRO (Registered Trade Mark) unit (manufactured by a Swedish Company, Iropa) which functions to supply yarn at a very low tension. This low tension may then be brought up to the desired value by the addition of the tension applied by the device in accordance with the invention.

In a particular example of the device in use in a yarn feed system as shown in Figure 4, the diameter of the tube bore 2 is 0.3 inches; the diameter of the expanded section 3 and of the branch passage 4 is 0.45 inches; the diameter of the flared opening 8 is 0.45 inches; the diameter of the guide tube 6 is 0.12 inches; and the yarn diameter is approximately 0.03 inches. The device is op rated with a pump which produces a pressure of about 12 inches water gauge in the expanded section 3 and a flow rate of about 4 cubic feet per minute through the tube bore 2.

While we have described the use of a device as shown in Figure 1, the suction arrangement shown in Figure 2 could be used equally as well. In fact, in some machines the suction device will be easier to fit since the expanded section of the tube and th attached pump would be located further away from the feeder than with the device shown in Figures 1 and 4.

The textile machine just described with reference to Figure 4 is also described and shown in the complete specification filed in respect of our divisional applications numbers (Serial No. 1,469,534) 33848/76 and 33849/76, Claim 1 of which covers a textile machine having a yarn feeder and a system for guiding yarn from a yarn package to the feeder, the yarn guiding system including a tensioning and slack take-up device comprising a tube which has openings at its opposite ends and which is arranged so that yarn drawn to the feeder passes unobstructed through the tube, and means connected to the tube for creating a pressure in the tub different from the ambient pressure beyond the ends of the tube, the arrangement being such that, in use, the pressure differential causes air to flow along the tube in a direc tion opposite to that in which the yarn is drawn, thereby exerting a drag on the yarn which maintains the yarn at the feeder in tension.

WHAT WE CLAIM IS:—

1. A device fod tensioning and/or taking up slack in a flexible material of continuous thread or sheet form, the device comprising a tube having an opening at each end and arranged so that the material can be drawn unobstructed through the tube, the tube comprising a section of expanded internal cross-section along part of its length, an unexpanded section of uniform cross-section between the expanded section and one end of the tube, and a flared section at each end of the unexpanded section, one flared section leading from the unexpanded section to the expanded section, and the other flared section leading from the unexpanded section to the opening at the said one end of the tube, the axial length of the unexpanded section being greater than the sum of the axial lengths of the flared sections at its opposite ends, and a branch passage which opens laterally into the expanded section and which has an internal cross-sectional area greater than that of the unexpanded section, the branch passage being arranged for connection to means for continuously creating a pressure in the branch

passage and in the expanded section different from the ambient pressure beyond the ends of the tube so that, in use, a pressure differential causes fluid to flow along the tube and exert a drag on material drawn through it.

2. A device according to claim 1, in which the internal cross-sectional area of the branch passage is at least twice as great as that of the unexpanded section of the tube.

3. A device according to claim 1 or claim 2, in which the tube has two unexpanded sections arranged one between the expanded section and each end of the tube, and the tube is symmetrical about the expanded section.

4. A device according to claim 1 or claim 2, in which the expanded section of the tube is located near one end of the tube, and the opening at this end of the tube is arranged with a cross-sectional area which is significantly less than that of the unexpanded section of the tube and that of the opening at the other end of the tube so that, in use, a substantial majority of the fluid which flows along the tube passes through the larger opening remote from the expanded section of the tube.

5. A device according to claim 4, in which the smaller opening at the end of the tube nearer the expanded section is provided by a tubular guide which projects coaxially into the expanded section.

6. A device according to claim 5, in which the tubular guide projects into the tube beyond the point at which the axes of the tube and the branch passage intersect.

7. A device according to claim 5 or claim 6, in which the inside of the tubular guide is formed with a series of axially spaced chambers which act as buffers to the escape through the guide of fluid from within the tube when the device is operated with a pressure in the expanded section greater than the pressure outside the device.

8. A device according to any one of the preceding claims, in which a pressure sensitive device is connected to the expanded section of the tube and is arranged to provide a signal when the pressure reaches a predetermined value.

9. A device according to any one of the preceding claims, in which a pump is connected to the branch passage for creating the pressure differential between the expanded section of the tube and the ends of the tube.

10. A textile machine having a system for guiding yarn from a yarn package to a feeder, the system including a device according to any one of claims 1 to 8 arranged so that yarn drawn to the feeder passes through the tube, and means connected to the branch passage of the device for creating the pressure differential which causes fluid to flow along the tube.

11. A weft knitting machine having a system for guiding yarn from a yarn package to a feeder, the system including a tensioning and slack take-up device according to any one of claims 4 to 7 arranged so that yarn drawn to the feeder passes through the tube, and means connected to the branch passage of the device for creating a pressure differential which causes air to flow along the tube, the arrangement being such that, in use, the air flow along the tube is in a direction opposite to that in which the yarn is drawn and exerts a drag on the yarn which maintains the yarn at the feeder in tension.

12. A machine according to claim 11 in which the yarn guiding system includes on the package side of the tensioning and slack take-up device a cymbal tensioner and an overdriven cylinder for reducing the tension applied to the yarn by the cymbal tensioner.

13. A machine according to claim 12, in which the yarn guiding system is arranged so that the yarn travels in a straight line, when under tension, from the overdriven cylinder through the tensioning and slack take-up device to the feeder.

14. A machine according to claim 13, in which the means for creating the pressure differential causes air to be blown along the tube from the expanded section, and an aerofoil surface is arranged adjacent the discharge end of the tube so that the exhausted air is deflected by the aerofoil surface and, in use, slack in the yarn is taken up as a loop produced between the aerofoil surface and a pot eye guide positioned between the aerofoil surface and the overdriven cylinder.

15. A machine according to any one of claims 11 to 14, in which a pressure sensitive device is connected to the expanded section of the tube and is arranged to provide a signal when the pressure reaches a predetermined value.

16. A machine according to any one of claims 10 to 15, in which the means for creating the pressure differential is a pump.

17. A device according to claim 1, substantially as described with reference to any one of Figures 1 to 3 of the accompanying drawings.

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1469533 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

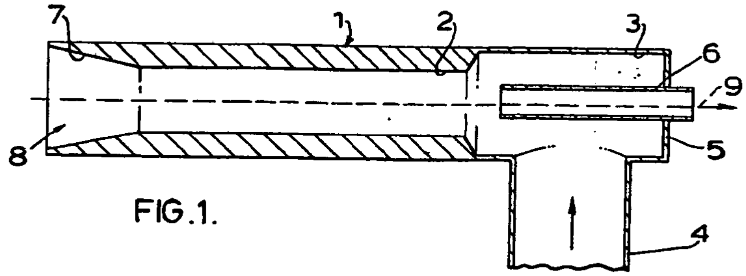

FIG.1.

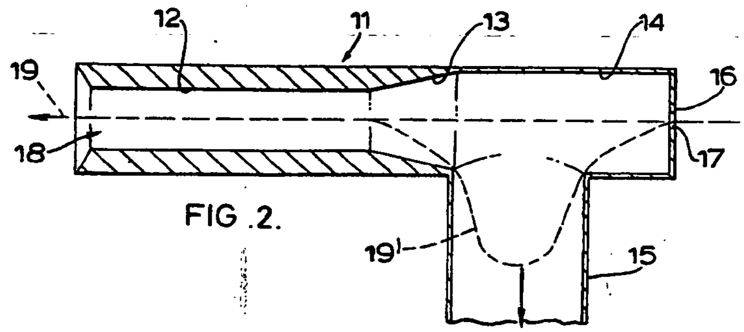

FIG.2.

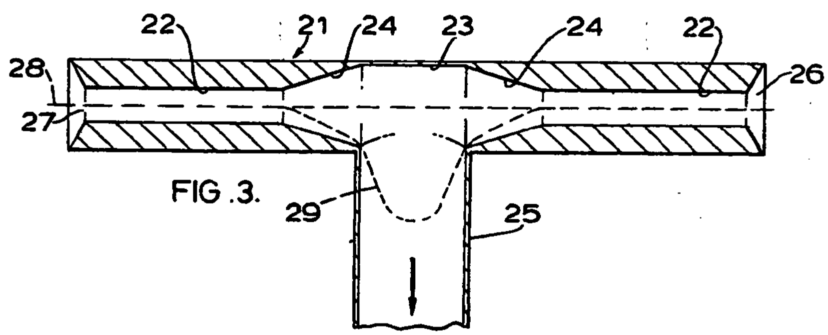

FIG.3.

1469533 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

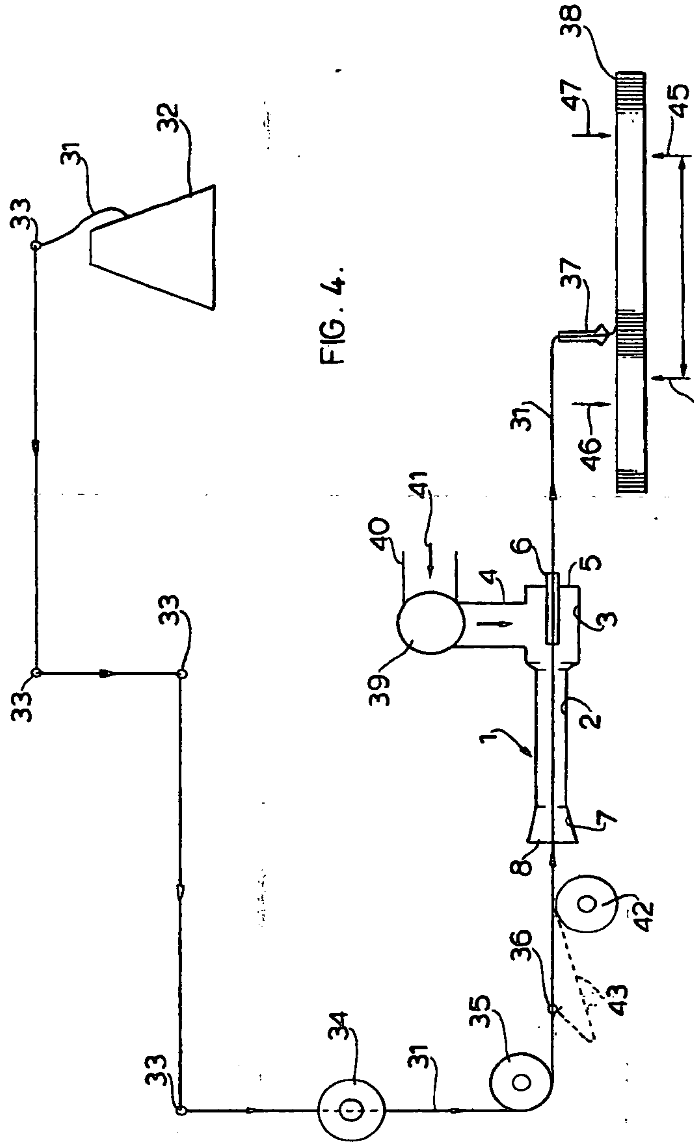

FIG. 4.